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Development of Mindset Theory Scale (Growth and Fixed Mindset): A Validity and Reliability Study

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Abstract

This study aims to develop a valid and reliable measurement instrument to measure the quality of Mindset Theories of students aged 14- 22. A systematic approach was followed to develop the measurement tool. 1145 students participated in the study (48% were female and 52% were male). Exploratory and confirmatory factor analysis were applied to determine the scale's construct validity. As a result of exploratory factor analysis, the scale was determined to consist of 19 items and four sub-dimensions. In line with the literature, these dimensions are called Procrastination, Immutability of Belief, Belief in Improvement and Effort. The four-factor structure of the scale was confirmed by confirmatory factor analysis. In addition, it was found that the differences between the averages of the upper and lower groups that make up 27% of the scale items are significant. When the results of the reliability analyses were examined from the perspective of the factors of the mindset theory scale, the values of 0.724 for the Procrastination sub-dimension and 0.805 for the Immutability of Belief sub-dimension of the Fixed Mindset dimension were found. It was found 0.701 for the sub dimension of Effort and 0.771 for the sub dimension of Belief of Mindset Theory Scale's Growth Mindset dimension. The internal consistency coefficient was found 0.723 for the Fixed Mindset dimension and 0.714 for the Growth Mindset dimension of the Mindset Theory Scale. These results shows that the Mindset Theory Scale measures students' mindset theories in a valid and reliable way.

Keywords

• Fixed Mindset • Growth Mindset • Mindset • Mindset Theory

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One of the most basic skills that education should provide to students is the awareness that learning is a task that needs to be continued all the time. The individual's ability to carry out learning actions continuously is only possible with the belief that he or she can change and improve himself or herself. In addition, the individuals' self-improvement is associated with the desire to learn and belief in their abilities. In line with these thoughts, non-cognitive skills have started to be considered as an important problem research area in educational studies. Non-cognitive skills generally refer to skills such as persistence, courage, endurance, resilience, self-sufficiency, mindset, effort, motivation, collaboration, and work habits (Farrington, et. al., 2012 as cited in Yilmaz, 2019). Many of these skills are also thought to be closely related to students ' academic achievement (Duckworth, 2009; Garcia, 2014). Hence, it is assumed that interest in studies to investigate the effects of individuals' non-cognitive skills on variables such as their cognitive learning will gradually increase (Fitzgerald &Laurian-Fitzgerald, 2016).

One of the non-cognitive skills is the Mindset Theory of individuals. Mindset Theory is the beliefs that individuals develop about their fundamental qualities (Dweck, 2016). Mindset Theory is associated with the mindset of individuals. Mindset includes thoughts, beliefs, emotions, motives and intentions (Ormrod, 2017). The mindset has been defined in different dimensions. First one of these is that mindset is cognitive activities performed to implement a particular task (Mather et al., 2013). According to the second dimension, mindset is the cognitive frameworks used to understand an event (French, 2016). Finally, the mindset can be defined as a belief that encompasses one's judgments about the flexibility of one's character or intelligence that one possesses (French, 2016). According to Dweck (2016) the mindset is the beliefs that people have their most basic qualities, such as their intelligence, ability, and personality. Students ' Mindset Theory is an explanation of their academic success, perseverance, persistence in the face of challenges, classroom participation, and feelings of academic involvement (Dweck et al., 2014). Based on all these explanations, the Mindset Theory can be defined/summarized as people's belief in the improvement of the abilities that individuals possess. Most of these abilities include intelligence. From this point of view, Mindset Theory is more associated with the belief that individuals' intelligence can be improved.

Students' mindsets are of critical importance because research has shown that students' mindsets affect the quality of learning processes, which in turn create different learning outcomes for students (Boaler, 2015). The Mindset Theory is not a cognitive skill, and there is an association between it and academic success (Laursen, 2015; Yilmaz, 2019). Considering all these, it can be argued that the Mindset Theory is a subject that needs to be explored with its different dimensions in the field of Education. Further research in this field can better describe students ' learning processes and achievements. These descriptions can help practitioners and policymakers. In order to do these, a valid and reliable measurement tool may be needed to describe students' Mindset Theory.

Six measurement instruments related to the mindset theory were found through a literature review. One of them is the 8-item single dimensional scale developed by Dweck (2006). The range of scores in this scale is 0-32. Scores between 0-16 indicate a fixed mindset, while scores between 16-32 indicate a growth mindset. The other scale developed by Dweck (2000) has two dimensions, fixed and growth mindset, and eight 7-point Likert type items. Midkiff et al. (2017), developed an 8-item, two-dimensional Growth Mindset scale. This scale is a psychometric scale developed in a sample of high school students in the UK. Ingebrigtsen's (2018) scale of growth mindset,

developed in his master's thesis with a sample of university students in Norway, has six items. The scale was found to be a valid and reliable psychometric scale. General Mindset Scale developed by Lottero-Purdue and Lachapelle (2019) for 10-11 age group is a 5-point Likert scale with six items and two dimensions. These dimensions are fixed and growth mindset theories. There is a 4-point Likert scale with 14 items developed by Abd-el-Fattah and Yates (2006) to identify individuals' beliefs about the nature of intelligence. This scale has two dimensions, Existence Theory and Incremental Theory.

Although it has been frequently cited in the literature in recent years (Busch, 2018; Rustin, 2016), there is a limited number of data collection tools for Mindset Theory that are exclusively for certain age groups and have been developed with particular focus on growth mindset. Thus, the lack of a comprehensive measurement tool that measures the Mindset Theory in a valid and reliable way is considered as a major gap in the field (Lüftenegger & Chen, 2017). In Turkey, there is no measurement tool that measures the mindset theory. This study aims to develop a data collection tool to measure the quality of adolescents' Mindset Theories. This scale aims to measure the mindset theories of students in adolescence. These years include formal education for most of the individuals. Adolescence comprises high school and university education periods. Adolescence is a period when psychological, mental and social development and maturation occurs and when individuals try to achieve the transition into adulthood (Ocakçı, 2015). Literature suggests adolescence in Turkey cover the age period between 11 and 20 (Çebi et al., 2016). Alternatively, Törüner and Büyükgönenç (2012) indicate that adolescence in Turkey starts at age 10-12 for girls and age 12-14 for boys and ends at age 21-24. Arnett (2004), states that the individual complete this period in late twenties and starts to feel as an adult. Considering these criteria about the adolescence, it was deemed suitable to design a measurement tool which would encompass individuals' high school and university education. At the same time, the planned measurement tool was expected to contribute to the research of various variables related to the individuals' educational process with regards to the mindset theory. In this context, the current research aims to develop a valid and reliable measurement tool for measuring the Mindset Theory qualities of students aged 14 and older.

Theoretical Framework

According to mindset theory, mindset has two dimensions. The first one is the Growth Mindset and the other is the Fixed Mindset (Dweck, 2008). Growth Mindset is the belief that one can improve one's intelligence, talents and skills (Fensterwald, 2015). Fixed Mindset is the belief that one's ability and intelligence have an invariant and unchanging structure. Individuals with this mindset believe they can accomplish a task to a certain extent with the characteristics they already have and therefore they think it is useless to strive (Dweck, 2016). The Mindset Theories of the individuals can be assumed to be an important predictor of their development and learning.

People whose Growth Mindset dimension of Mindset Theroy is developed assume that one's abilities and skills can develop through hard work (Laursen, 2015). These individuals believe that intelligence has improvable rather than a static structure (Claro et al., 2016). They believe that they can improve their intelligence, that learning is more important, that it is important to stand up to mistakes or failures. They tend to see mistakes as an opportunity to improve, make inferences from others' success and learn from their experiences. They think they should strive for

improvement by leaving their comfort zone (Beere, 2019). Growth Mindset is also associated with the individuals' belief in their capability to improve their intellectual abilities (Claro et al., 2016). Intellectual abilities refer to verbal and/or non-verbal mental skills, abstract reasoning, problem solving, mental speed or memory (Pfeiffer & Jarosewich, 2003). Individuals' beliefs that they can improve these intellectual competencies can enable them to develop a positive perspective towards themselves. According to Achor (2012), when individuals work with a positive mind set, their performance, productivity and creativity improve at almost all levels. Growth Mindset of Mindset Theory is also the belief that one can develop one's mental capacity like a muscle and make it stronger (Aronson et al., 2002). Growth Mindset calls for motivation and self-regulation to achieve a goal. For example, individuals with Growth Mindset of Mindset Theory are more likely to continue and repeat their efforts when faced with difficulties (Burnette et al., 2013).

Growth Mindset is a variable that positively affects students' academic achievement (Blackwell et al., 2007; Yeager et al., 2014). Growth Mindset is also associated with individuals ' traits of openness, responsibility, extraversion, compatibility and emotional balance (Lindgren et al., 2019). Students with Growth Mindset believe that they can learn the concepts, formulas, information etc. within a course with faith and determination. These students believe that it is possible to learn from mistakes and know that it is a way of learning. They are aware of the necessity of linking new information with past information in order to learn lesson topics and to make sense of the subject. Besides, they know the importance of taking time to think deeply and to really understand what they are learning instead of just rote memorization of course subject (Szpirglas & Saint-Onge, 2018). Growth Mindset may also require effort in the process of change and improvement. Effort is defined as struggle, zeal and desire to work (Turkish Language Society [TDK], 2020). Zealous individuals may be willing to do any work and they do not give up. They can struggle to achieve something and they believe they can change it. The diligence of individuals can make their growth mindset more dominant.

The other dimension of mindset theory is the Fixed Mindset. Individuals whose Fixed Mindset of Mindset Theory is developed believe that their mental abilities, characters and creativity skills are immutable traits given to them, and they do not make any effort to change or improve them. These people avoid taking the risk of engaging with new situations that require effort because they are afraid of making mistakes, perform under their real capacity (Güven &Yılmaz, 2017). Contrary to the people with Growth Mindset of Mindset Theory, people whose Fixed Mindset dimension is developed are more likely to escape from a difficult task and feel helpless in such a situation (Burnette et al., 2013).

Individuals with a developed fixed mindset dimension of Mindset Theory may be in procrastination. Procrastination can be defined as the tendency of the individual to delay his or her actions and plans for some reason, and to feel a stasis and laziness (Sekman, 2007). Individuals in procrastination may experience insufficient levels of motivation, lack of self-regulation, lack of empathy and socialization, and a sense of learned helplessness (Çankaya, 2010). People who are in procrastination may have tendencies such as stagnation, inaction, passivity, monotony, laziness, and they may be willing not to take action (Çankaya & Demirtaş, 2010). These people may not be open to

innovation, they may be reluctant to change the way they work and think. They may even see these changes unnecessary.

Method

Study Sample

The population of the study consists of 18778 high school students studying in a central district of Konya and 7524 university students from a faculty of education in the same district, which makes a total of 26302 students. Sample size needs to be at least five times or even almost ten times the number of items when developing a scale (Bryman & Cramer, 2001). Sample size of 100 is considered to be weak, whereas 200 is medium, 300 is good, 500 is very good and 1000 is perfect (Comrey & Lee, 1992). The draft version of the scale had 26 items. To perform exploratory and confirmatory factor analysis, a sample size between 260 and 500 was considered to be appropriate. The sample size was decided to be 700. Multi-stage sampling was used. The high schools in the universe were separated into stages according to their types (General, Science, Vocational), while university students were categorized according to their entry scores (Mathematics/Science, Social Science/Humanities, equally-weighted, General Ability). These students were divided into substages according to their grade/year. Grade level substages were accepted as clusters. 717 students comprised the sample of the scale development process via random cluster sampling. This sample was randomly divided into two to use one half for exploratory factor analysis and the other for confirmatory factor analysis. Of the participants, 18% were in 8^{th} grade, 17% were in 9^{th} grade, 16% were in 10^{th} grade, 18% were in 11^{th} grade, 11% were in 12^{th} grade and 20% were in university. The understandability of the items in the draft scale was established in a group of 102 students chosen via random cluster sampling from the high school first year substage of the universe. Test-retest reliability of the scale was tested with 124 students chosen from the high school third year substage of the universe via random cluster sampling. Finally, criterion validity of the scale was tested with 202 students chosen from high school second year substage of the universe via random cluster sampling. Clusters used in the stages of scale development were excluded from the universe to prevent them from being included in the other stages of development.

Data Collection Tools

The Short Grit Scale developed by Sarıçam et al. (2016) and The Psychological Hardiness Scale developed by Işık (2016) were used as criteria to determine the criterion validity of the Mindset Theory Scale (MTS).

The Short Grit Scale: Determination and effort constitutes a part of the Mindset Theory's scope of includes determination and effort. For this reason, the researcher decided to use The Short Grit Scale developed by Sarıçam et al. (2016). The Short Grit Scale is a 2-dimensional scale with 8 items. Overall Cronbach Alpha internal consistency reliability coefficients were calculated as .83 for the scale, .80 for the consistency of interest sub-dimension, and .71 for the persistence in effort sub-dimension.

The Psychological Hardiness Scale: The Mindset Theory also includes the belief that intelligence can improve and one can improve oneself diligently. Considering that these beliefs are related to dedication, control and challenge, the researcher decided to use the The Psychological Hardiness Scale developed by Işık (2016) as a

criterion fort the MTS developed in this study. The Psychological Hardiness Scale consists of 21 items and three sub-dimensions. These dimensions are Dedication, Control and Challenge. While the overall Cronbach alpha reliability coefficient is .76 for the scale, the Cronbach alpha reliability coefficient for each sub-dimension is between .62 and .74.

Development of the draft scale: Draft form of MTS and personal information form were used to collect the necessary data that would be used in the research. In the preparation of the draft version of MTS, the scale development stages such as creating a pool of items, obtaining expert opinions, pilot implementation, determining validity and reliability were followed (Şeker & Gençdoğan, 2014; Tavşancıl, 2005). The theoretical structure and research results in the relevant literature were utilized in the development of the draft items of the MTS (Anderson & Glover, 2017; Baruch-Feldman, 2017; Beere, 2019; Boaler, 2015; Breuning, 2015; Dweck, 2016; Ricci, 2013a; Ricci, 2013b; Ricci & Lee, 2016; Sternberg et al., 2011; Szpirglas & Saint-Onge, 2018; Yılmaz, 2019).

Mindset Theory qualities were considered with their dimensions and items were prepared in a way suitable for the study. Experts who have conducted studies in the theories of thought, intelligence, brain and mindset and who have academical studies in these fields (7 experts in their fields) were consulted before the finalization of MTS. The experts expressed their views on the content, structure, applicability and meaning of the items. Moreover, a questionnaire was developed to evaluate the experts' evaluation of the items in the draft scale. The experts were asked to score every item on scale of 1-4 (1: not suitable, 2: needs major correction, 3: needs minor correction, 4: very suitable). The conformity of the expert opinions was tested with Kendall's coefficient of concordance. Kendall's analysis performed showed that there was not a statistically significant difference between expert opinions (Kendall's W = .160, p = .308). In line with the written opinions of the experts, the necessary changes, corrections and item removals were made. The draft scale was evaluated by three linguists in terms of language, expression and statement. Taking into account the opinions of linguists, changes and corrections were made in some items in terms of spelling, form, language and expression. As a result of these revisions, the draft scale was reduced from 33 to 26 items.

Finally, the 26-item draft form of MTS was evaluated by assessment and evaluation experts and answering format and possible choices were decided. It was decided to use a 5-grade likert type and the choices were: "It is very suitable for my thoughts (5 points)", "It is suitable for my thoughts (4 points)", "It is partially suitable, partially not suitable for my thoughts (3 points)", "not suitable for my thoughts (2 points) and "Not suitable for my thoughts at all (1 point)". In accordance with measurement and evaluation experts' suggestions, the items in the Mindset Theory Scale were scored as 5-4-3-2-1. Then, the draft scale was finalized by adding instructions.

The draft scale was applied to 102 students studying in 9th grade During the application, students were asked to mark the items they did not understand. Immediately after the implementation of the draft scale, students' opinions on the intelligibility of each item of the draft scale were received. At the end of the application, problems in the implementation was considered and some revisions in terms of spelling and typos were made in the scale, in line with the opinions of the students. Finally, the draft scale was examined by linguistics experts in terms of language, expression and statement and the draft of the MTS was finalized.

The final draft scale was applied to 717 students. It was observed that the scale could be answered by participants in 10-11 minutes. During the application process, students were given information about the personal information form and how to implement MTS, and explanations were made about the issues that were not understood by the students.

Data Analysis

The existence of missing data in the data collected in the research process was examined. Substracted data can be tolerated if its ratio is below 5% and it has normal distribution (Acuna and Rodriguez, 2004). Therefore, two missing data was excluded from the data set. There is a possibility of outliers when the assumption of normality is examined in a data set. Unidirectional outliers in the data set can be checked by converting item scores to Z values (Tabachnick and Fidell, 2007). 4 data points with Z values outside of +3 / -3 interval were accepted as unidirectional outliers and excluded from the data set. Then, outliers and multivariate normality assumption in the dataset was examined through Mahalanobis distance values and 6 data points were not included in the analyses based on their possibility of being outliers ($p < 0.01$). Moreover, univariate normality assumption was evaluated by checking skewness and kurtosis coefficients. The skewness and kurtosis values of the data set were found to be between +1 and -1, which is the interval for normality assumption (Morgan et al., 2004). After these stages, the dataset was reduced to 705 participants.

During the analysis of the items of MTS, item analyzes and exploratory and confirmatory factor analyzes were carried out to determine the construct validity. According to Doğan et al. (2017), if the necessary minimum sample size for conducting both EFA and CFA with the data obtained from the same sample is reached, that sample can be divided into two to perform these. In this regard, data obtained from the same sample was randomly divided into two for EFA and CFA. 353 people randomly selected from the half of the same sample was used for EFA while 352 people were used for CFA. Before conducting EFA the suitability of the data set for factor analysis was checked by Kaiser-Meyer Olkin (KMO) and Barlett tests. Item-total score correlation values were analyzed to determine whether the draft scale items were related to the scale. The structural validity of MTS was tested through factor analysis. The correlation coefficients between the scores of MTS's subdimensions were found. 4 factor structure resulting from EFA was tested by single level CFA. Two latent variables were added to the single level factor analysis to test two level factor model. As a result of the test of two level factor model, Cronbach alpha internal consistency coefficient method was used to determine the reliability of the scales. To check whether the items have differentiated in lower and upper groups, t-Value, average of the scores received from the items and their standard deviation were calculated. Correlation coefficients between the scores of the sub-dimensions of MTS were found. With the latest version of the scale, Pearson Product-Moment Correlation coefficient was used in the process of the test-retest method to estimate stable measurements within the scope of the scale and its reliability. In order to estimate the criterion validity of MTS, the Short Grit Scale developed by Sarıçam et al. (2016) and the Psychological Hardiness Scale developed by Işık (2016) were used as criteria. In order to estimate the relationship between these scale scores, the Pearson Product-Moment Correlation coefficient correlation technique was used. To test whether the total score

from MTS can be used, three level multifactor analysis was conducted. A scoring guideline for MTS was created by gradient sum technique.

Ethical Aspect of the Research

In this study, all the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. None of the actions specified under the second section of the Directive, "Scientific Research and Publication Ethics Actions" have been carried out.

Ethics committee permits

Ethical evaluation committee: Necmettin Erbakan University Scientific Research Ethic Commission

Date of the ethical evaluation decision: 08.05.2020

Ethical evaluation document number: 2020/13

Finding

The validity and reliability estimation processes of MTS are explained below.

Item Analysis

First of all, in order to determine whether the draft scale items are related to MTS, item analysis was performed. When the item-total score correlations of MTS are examined, it can be seen that the relevant values vary between 0.117 and 0.451. Most of these values were found to be above 0.30. In general, it is stated that item-total score correlation is suitable for items above 0.30, but if the values between 0.20-0.30 are deemed appropriate, they can be used for testing (Büyüköztürk, 2015). For this reason, it is accepted that the items in the scale are suitable for the analysis.

Construct Validity

Exploratory factor analysis (EFA) of the mindset theory scale (MTS): While developing psychometric tests, the stages of analyzing the suitability for factor analysis, performing factor analysis, determining the factors and naming the factors should be followed in order to determine the construct validity (Kalaycı, 2014). The stages suggested by Kalaycı (2014) were followed in the Exploratory Factor Analysis of MTS.

In order to determine the suitability of the data collected for the MTS development process to factor analysis, the Kaiser-Meyer-Olkin (KMO) coefficient, Bartlett's test of sphericity result and the diagonal values of the data matrix were analyzed. KMO coefficient was calculated as 0.866 for the collected data. In addition, the Bartlett's test chi-square value was statistically significant (X^2 = 5982,354; p <0.01). All of the diagonal values in the anti-image matrix are greater than 0.50. In line with these results, it has been accepted that the data collected for the Growth Mindset scale provide the necessary conditions for factor analysis. Because, according to Büyüköztürk (2015), it is sufficient that the KMO coefficient is above 0.60 and the Bartlett test results are significant, whereas according to Pett et al. (2003), the main diagonal elements of the anti-image matrix is an indicator of the suitability of the items for factor analysis.

Literature shows that mindset theory is comprised of mental dimensions that are independent from each other and open to development (Dweck, 2016). Therefore, varimax rotation was used when the factor loads for EFA was calculated via Principal Component Analysis. Because varimax method reveals simple meaningful factors by rotating factor variances to maximum with few variables (Tavşancıl, 2005).

According to Büyüköztürk (2015), the factors with eigenvalue greater than 1 are important factors when interpreting the data obtained by Exploratory Factor Analysis. It is a good standard to have a factor load of at least 0.45 in order for a substance to be summed under a factor. This value can be lowered to 0.30 if necessary. Based on these explanations, it is considered that their eigenvalues are greater than 1 and factor loads are at least 0.40 for items to be included in a factor.

As a result of EFA, Scree Plot (Figure 1) was analyzed. According to Scree Plot (Figure 1), the number of X-axis components is four at the breaking point where the slope disappears. It was therefore decided that the number of important factors could be at least four.

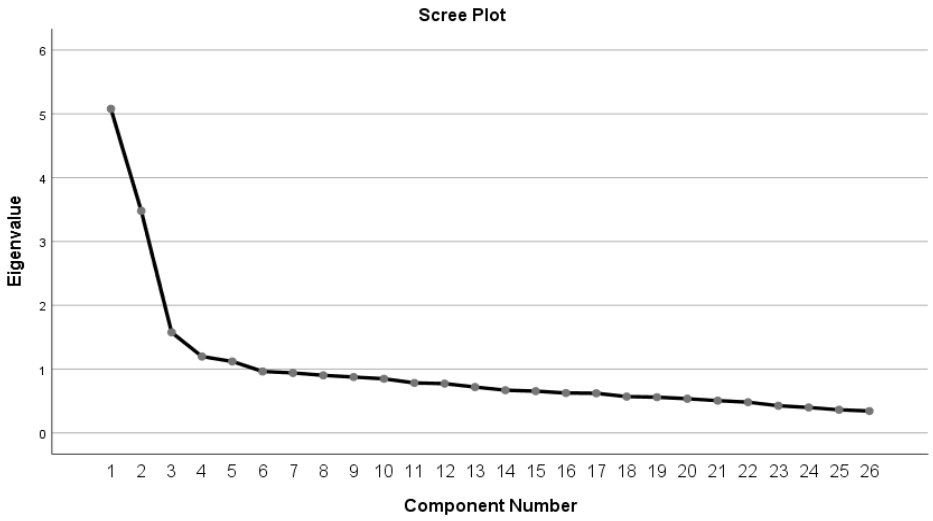

Figure 1. Scree plot of the Mindset Theory Scale

In this study, it is accepted that a four-factor structure may be possible considering the factors and theoretical foundations with eigenvalues greater than 1.

Of the 26 items belonging to MTS, 7 overlapping items (i9, i4, i2, i3, i3, i7 and i26) with a factor load below 0.40 or loaded into multiple factors were respectively excluded from the analysis. EFA was performed again in each item extraction. Experts were counselled at each step of item extraction. Based on experts' opinions it was decided that said items did not have cohesion with the other items composing a factor and that extraction of said items would not cause the scale to be inadequate in measuring its scope. Consequently, a structure with 4 sub-factors and a total explained variance ratio of 51,320% was obtained. The factor loads obtained from the EFA and the factor loads of the items are shown in Table 1.

Table 1

Rotated component matrix of the Mindset Theory Scale (varimax)

Components				
Items	1	2	3	4
i1				,708
i5				,683
i20				,525
i21			,683	
i8			,755	
i12			,713	
i15			,623	
i18			,502	
i22		,513		
i6		,763		
i10		,773		
i23		,777		
i16		,440		
i24	,602			
i7	,640			
i11	,411			
i14	,626			
i25	,736			
i19	,738			

Variance Total: 51,320, Factor 1: 22,750%, Factor 2: 15,224%, Factor 3: 7,757%, Factor 4: 5,589

When Table 1 is examined, it can be seen that factor loads obtained in Exploratory Factor Analysis are between .411 and .777. The factor loads are above 0.40 which is accepted as the lower limit. When the factor load values of the items are analyzed, it is clear that the items loaded on the factors measure the desired structure appropriately. The factors obtained are named by considering the items they contain. Accordingly, the first factor consisting of 6 items (i24, i7, i11, i14, i25 and i19) was named as “Procrastination”, the second factor consisting of 5 items (i22, i6, i10, i23 and i16) was named as “Belief in Improvement”, the third factor consisting of 5 items (i22, i6, i10, i23, ve i16) was named as "Effort", and the fourth factor consisting of 3 items (i1, i5 and i20), was named as "Immutability of Belief".

Table 2

Correlation coefficients between the factors of Mindset Theory Scale

Mindset Theory Scale's Dimensions		Procrastination	Immutability of Belief	Belief in Improvement
Immutability of Belief	r	,548**		
Belief in Improvement	r	-,174**	-,287**	
Effort	r	-,184**	-,140**	,393**

**: p<.01; *: *Bayram, 2013; Hu and Bentler, 1999; Schumacker and Lomax, 2004*

The correlations between the sub-dimensions of the scale ranged from -.287 to .548 and had a significant relationship at the level of .05 (Table 2).

The model resulted from EFA was tested in CFA to check construct validity (Kline, 2011).

Confirmatory factor analysis (CFA) of mindset theory scale: Confirmatory Factor Analysis (CFA) is used with EFA in scale development studies. Using CFA, the extent to which the existing theoretical structure overlaps with the available data can be tested (Schumacker & Lomax, 2004). The MTS model obtained from EFA, which includes 19 items with 4 factors, was subjected to confirmatory factor analysis. CFA analysis revealed that model fit values of 19 statements in the scale were not at an acceptable level. In the model created as a result of CFA error variance of 6 items were quiet high while their regression weights were very low, which made the authors think that these items were not fitting the structure of the scale. These six items were extracted from the model one by one and the model was tested again. Accepted values for fit indices were achieved at the last stage of repeated fit index calculations. Experts were counselled each time an item judged to be unfit was extracted from the model due to the concerns about the content validity of the scale. In the opinions received from the experts, it was noted that there were other items measuring the quality measured by the problematic items more comprehensively and that the scale would not lack content validity if the said items were removed. In light of these opinions, item numbers of MTS were revised as the number of items was down to 13 due to the removal of 6 items. Another model was created with these revised numbers and fit index calculations for the constructed model had adequate values. The diagram obtained from CFA for the validity study of MTS, after all the revisions, is given in Figure 2.

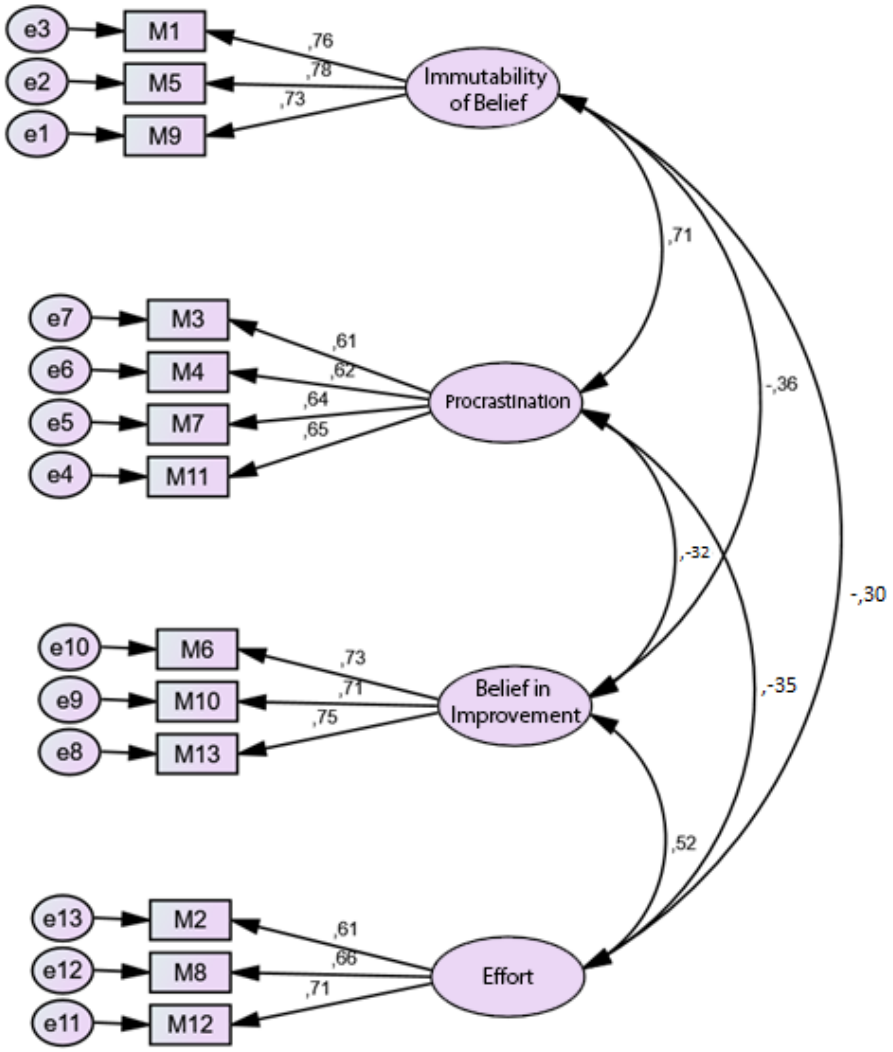

Figure 2. CFA results of Mindset theory scale: Standardized path diagrams (path analysis)

When the path diagrams of MTS related to CFA in Figure 2 are inspected, it is seen that the standardized path coefficients of the items vary between 0.61 and 0.78 (Figure 2). Kline (2005) states that items having standardized path coefficients of 0.50 or more represent the relevant variable. When the standardized path coefficient of the items in model are inspected, it can be thought that these items have adequate predictive value. Also, fit index values for this model are presented in Table 3.

Table 3

Compliance index values and comparison of the CFA results of the Mindset Theory Scale

Model	χ2/sd	GFI	CFI	IFI	AGFI	NNFI	RMSEA
	144,874./59=2,455	,966	,964	,964	,947	,941	0,047
Fit comment*	Perfect fit	Perfect fit	Perfect fit	Perfect fit	Perfect fit	Acceptable fit	Perfect fit

It is seen that the fit indices of the scale obtained with 4-factor by CFA of MTS generally have good values. The ratio of chi square value to degree of freedom is (χ2/sd=2,455. GFI (Goodness of Fit Index), CFI (Comparative Fit Index), IFI (Incremental Fit Index) and NNFI (Non-Normed Fit Index) compliance indices are close to 0.95 and RMSEA value is less than 0.05, which indicate that the model fits well with the data. The fit indices obtained for the scale in this study can be accepted as evidence that the proposed model matches the data at hand (Bayram, 2013; Hu and Bentler, 1999; Schumacker and Lomax, 2004).

Meydan and Sesen (2011) state that second-level multifactor models of multidimensional scales must also be tested when applying confirmatory factor analysis. Mindest Theory is primary interpreted as two dimensional. These dimensions are Fixed and Growth Mindset (Dweck, 2016). Based on literature, the subdimensions of Mindset Theory revealed by EFA and confirmed at single level, "Procrastination", "Immutability of Belief", "Effort" and "Belief in Improvement", were expected to be related to a higher level variable. The relationship of these 4 subdimensions with two latent variables was tested in a two-level multifactorial model. The second-level CFA results for this four-subdimensional, two-dimensional model is shown in Figure 3.

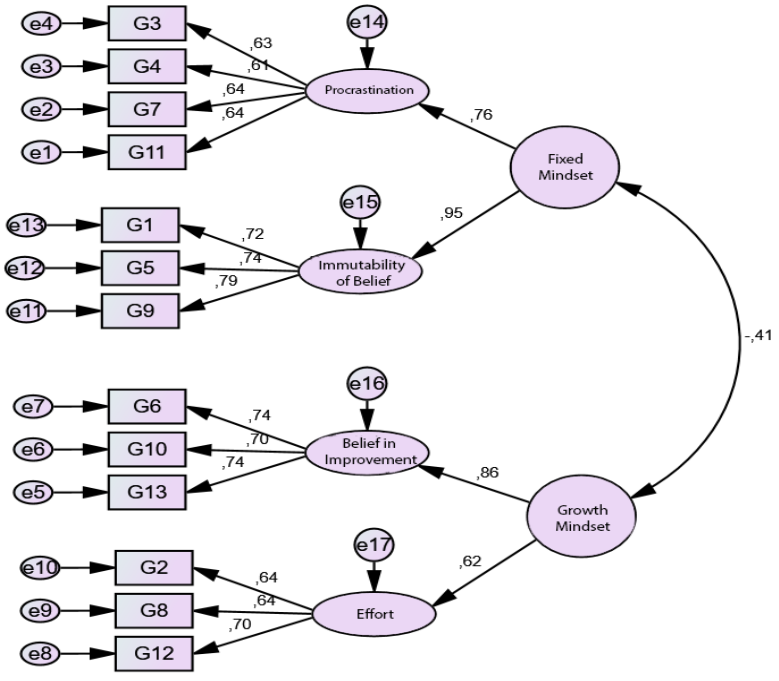

Figure 3. Second level CFA results of Mindset Theory Scale: Standardized path diagrams

A second-level confirmatory factor model was created to show that four factors obtained in the first level CFA represent theoretically proposed Mindset Theory in two higher level dimensions. More specifically, Procrastination and Immutability of Belief are loaded on one higher level dimension while Effort and Belief in Improvement on another (Figure 3). The second level factor model was tested by adding two latent variables named Fixed Mindset and Growth Mindset to the first level confirmatory structure tested with 4 latent and 13 indicator variables. The goodness of fit values is given in Table 4.

Table 4

Mindset Theory Scale second-level CFA results fit index values and their comparisons

Model	χ2/sd	GFI	CFI	IFI	AGFI	NNFI	RMSEA
	155,805/60=2,597	,964	,960	,960	,945	,937	0,050
Fit comment *	Acceptable fit	Perfect fit	Perfect fit	Perfect fit	Perfect fit	Acceptable fit	Perfect fit

* (Bayram, 2013; Hu and Bentler, 1999; Schumacker and Lomax, 2004)

Results of first level and second level CFA indicate that MTS is a valid measurement tool that can be used to determine the total Fixed Mindset levels, the Procrastination and Immutability of Belief levels, and the total Growth Mindset levels and Effort and Belief in Improvement levels.

Table 5 presents the item-total score correlation values of the items of the scale, factor loads, t-value for the lower and upper group difference, the mean and standard deviation of the scores received.

Table 5

The rotated components matrix of the Mindset Theory Scale (varimax)

	Item No	EFA factor load	T value for upper and lower group difference	Item average	Standard deviation
Procrastination	G3	-,602	24,90**	2,84	1,29
	G7	-,640	27,89**	2,71	1,35
	G4	-,736	25,27**	2,47	1,36
	G11	-,738	29,59**	2,36	1,41
Immutability of Belief	G1	,708	38,14**	2,90	1,37
	G5	,683	38,58**	2,76	1,35
	G9	,525	31,54**	2,59	1,32
Effort	G8	-,755	22,89**	4,10	1,00
	G12	-,713	28,11**	4,06	,99
	G2	-,623	23,55**	4,03	,98
Belief in Improvement	G6	,763	21,46**	4,46	,79
	G10	,773	26,02**	4,31	,86
	G13	,777	31,08**	4,17	,94

**: p<.01

Factor loads of MTS are over 0.525 and there is a significant difference between the upper and lower group item mean scores. Hence, it can be said that MTS differentiates individuals scoring high and individuals scoring low on the scale.

Criterion-related validity of mindset theory scale: In order to examine the criterion validity of MTS, Short Grit Scale and the Psychological Hardiness Scale were used. The correlation coefficients were calculated between the total scores obtained from the scales (Table 5).

Table 6

Criterion validity results of Mindset Theory Scale

		Grit	Psychological Hardiness
Growth Mindset	r	,399**	,556**
Fixed Mindset	r	-,312**	-,358**

**: p<.01

A positive and significant relationship was found between Growth Mindset and Psychological Hardiness scores (p <05) (Table 6). A significant positive relationship was found between Growth Mindset scores and Grit scores (p <05). A significant negative relationship was found between Fixed Mindset and Psychological Hardiness scores (p <05). A significant negative relationship was found between Fixed Mindset scores and Grit scores (p <05). These results show that the Mindset Theory Scale has criterion validity. Evans (1996) states that Pearson correlation coefficient r values of <0.40-059 is medium and -.20 - -.39 is weak. The relationship between MTS and criterion measures of Psychological Resilience and Perseverance can be said to be weak and medium.

Findings on the reliability of the mindset theory scale: To determine the reliability of MTS, item properties were determined using item analysis. Total scores of the items with their correlations were calculated. To further examine the reliability of the dimensions and the sub-dimensions of the MTS, the internal consistency of the items that make up the scale was estimated by the Cronbach-Alpha coefficient method. All these results are given in Table 7.

Table 7

Some reliability analysis values of the scale items of the Mindset Theory Scale

		Item no	Item-total score correlation	Cronbach alpha internal consistency coefficient	
Fixed Mindset	Procrastination	G3	,475	0,724	0,723
		G7	,506		
		G4	,522		
		G11	,547		
	Immutability of Belief	G1	,654	0,805	
		G5	,679		
		G9	,595		
Growth Mindset	Effort	G8	,519	0,701	0,714
		G12	,552		
	Belief in Improvement	G2	,474	0,771	
		G6	,609		
		G10	,600		
		G13	,615		
Whole of the scale				0,803	

Item-total score correlation of items of MTS varies between 0.474 and 0.667. The Cronbach Alpha internal consistency coefficient was examined to determine the scale's reliability. The internal consistency coefficient of MTS is 0.803 the reliability values of the four factors of MTS, Procrastination, Immutability of Belief, Effort and Belief in Improvement, were 0.724, 0.805, 0.701 and 0.771 respectively. The internal consistency coefficient of MTS is 0.803.

Test-retest results: In order to determine the reliability of the scale with test-retest method, MTS was applied to 102 students (8th, 9th, 10th, 11th, 12th and university students) with an interval of four weeks. The relationship between their scores was calculated using the Pearson Product-Moment Correlation coefficient. The results are presented in Table 8.

Table 8

Results on the test-retest results of the Mindset Theory Scale

			2nd Applıcatıon scores	
			Growth mindset	Fixed mindset
1st Application Scores	Growth Mindset	r	,380**	-
	Fixed Mindset	r	-	,470**

**: p<.01

A positive weak and medium significant relationship was found between the first and second application scores of the dimensions of MTS (Evans, 1996). These results indicate that MTS does not make strongly stable measurements. Overall, all of the analyzes conducted to determine the reliability of the MTS indicate that the reliability of the scale is sufficient.

In conclusion, the EFA results revealed that the scale has four dimensions is a four-dimensional structure. The model created by EFA was tested with CFA and the compliance values have been sufficient and acceptable. In the CFA analysis conducted at the second level, it was found that the sub-dimensions of Procrastination and Immutability of Belief were represented in the Fixed Mindset upper dimension, and the Effort and Belief in Improvement sub-dimensions in the Growth Mindset. The scale was observed to have criterion validity. It was found that the internal consistency coefficients were at a good level and made stable measurements in the results related to the reliability of MTS. It can be said that the scale is a reliable and valid scale by considering all values related to MTS.

Whether Fixed and Growth Mindset dimensions of MTS are components of Mindset Theory was tested in a three level factor analysis. To this end, the results of a three level CFA to test the possibility of 4 subdimensional and 2 dimensional structure to be a component of a higher dimension and the suitability of the scale for the use of its total score are shown in Figure 4.

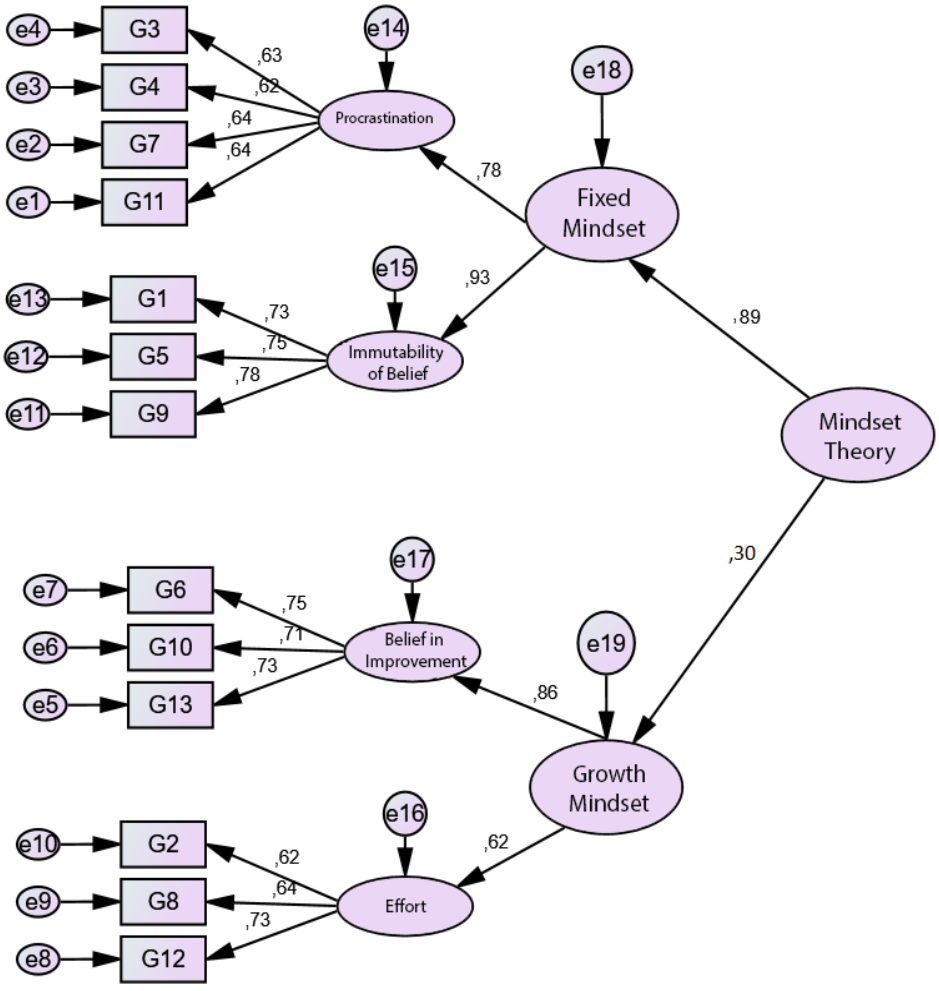

Figure 4. Three level multi factor model for Procrastination, Immutability of Belief, Effort and Belief in Improvement subdimensions of MTS's Fixed and Growth Mindset dimensions.

To test the possibility of using total scores for MTS a three level multi factor model was created. When the values related to the model in the Table 9 were reviewed, it was understood that fit indices were at an acceptable level. These values show that items represent a higher level with the factor they belong to. According to these results, it may be acceptable that the total score of the scale can be used.

Table 9

Fit indices of three level CFA results of MTS scale and their comparison

Model	χ2/sd	GFI	CFI	IFI	AGFI	NNFI	RMSEA
Fit comment*	155,805/60=2,597	,964	,960	,960	,945	,937	0,050
	Acceptable fit	Good fit	Good fit	Good fit	Good fit	Acceptable fit	Good fit

Scoring of the mindset theory scale: The score evaluations regarding the dimensions of the developed MTS are given in Table 10.

Table 10

Scoring table of Mindset Theory Scale

Dimensions and sub-dimensions of mindset theory scale	Items	The lowest possible score	The highest possible score
Procrastination	3,4,7 and 11	4	20
Immutability of Belief	1,5 and 9	3	15
Effort	2,8 and 12	3	15
Belief in Improvement	6,10 and 13	3	15
Fixed Mindset	3,4,7,11,1,5 and 9	7	35
Growth Mindset	2,8,12,6,10 and 13	6	30
Growth Mindset	1*, 2, 3*, 4*, 5*, 6, 7*, 8, 9*, 10, 11*, 12, 13	13	65

(*: Items requiring reverse scoring at the total score stage of the scale)

MTS was accepted to be scored in accordance with gradient sum technique. The score obtained from a scale suitable for gradient sums technique is generally is the sum of scores of responses to the items in the scale (Tezbaşaran, 1996). In the Likert type scale like MTS, the participants state the degree to which they agree with the attitude element contained in the each statement in the scale. Information regarding to whether the participant's attitude is positive or negative based on self-judgements of the participant's total score from the scale by the gradient sums technique (Tavşancıl, 2005; Tezbaşaran 1996). When MTS is applied, the participant responses to each item in the scale and states the degree of his/her attitude towards the item. The score corresponding to this degree is the participant's score on that item. The total score of MTS is obtained by summing the scores of subdimensions belonging to the dimensions.

MTS can be scored separately with its dimensions and sub-dimensions. Points can be obtained in the range of 7 to 35 from the Fixed Mindset dimension of the MTS. While the Procrastination sub-dimension of this dimension can be scored in the range of 4-20, the Immutability of Belief sub-dimension can be scored in the range of 3-15. Points from 6 to 30 can be obtained from the MTS's Growth Mindset dimension. A score of 3-15 can be obtained from the Effort sub-dimension of MTS's Growth Mindset dimension, while the other sub-dimension Belief in Improvement can be scored from 3 to 15. When the literature is examined, the Mindset Theory is more often called the Growth Mindset. For this reason, it is thought that there may be researchers who want to get a total score from the scale. In order to get total points from the scale, items number 1, 3, 4, 5, 7, 9 and 11 of the scale are reverse scored. These items are items that are collected under the Fixed Mindset dimension. These items are reverse scored only if one wants to obtain total scores from the entire scale.

The high score obtained from each dimension and sub-dimensions indicates that the person has a high level of competence in the relevant dimension and sub-dimension, and a low score indicates that the competence in the relevant dimension and sub-dimension is low. This evaluation is also valid for the score obtained from the whole scale.

Discussion, Conclusion and Recommendations

Fixed and Growth Mindset dimensions of the Mindset Theory have become important in terms of students' learning processes. Education stakeholders need to understand the importance of the Mindset Theories and be aware that this effects their performance (Baldwin, 2019). Therefore, the Mindset Theory has become an important field of study. For the studies to be carried out in this area, a measurement tool may be required to describe the Mindset Theories. In this context, in this study, it was aimed to develop a measurement tool to describe the mentality theories of students over the age of 14.

No Turkish language scale was found in the literature to describe the students' Mindset Theories. The scales developed in different countries had some limitations because the scales are generally focused on the growth mindset theories of individuals and do not cover any information about the qualities of the fixed mindset. In addition, these scales do not give information about individuals' efforts and motivations for the development of their talents.

There are two dimensions of MTS, each with two sub-dimensions. It is a scale that determines the students' own qualities according to their own perceptions. The subdimensions of the Growth Mindset dimension of MTS are Belief in Improvement and Effort. The MTS's Fixed Mindset dimension consists of the sub-dimensions of Procrastination and Immutability of Belief. The Growth Mindset dimension of MTS includes items 2, 6, 8, 10, 12 and 13. Some of the items in this dimension are as follows: "It is up to me to develop my intelligence", "I try to learn lessons from my mistakes". MTS's Fixed Mindset dimension includes items 1,3,4,5 7,9 and 11. Some of the items in this dimension are: "I believe my intelligence level will not change.", "I feel threatened while doing something/a job".

The Procrastination sub-dimension of the Fixed Mindset dimension of the MTS measures the students' tendency to delay their actions, their stasis, their laziness, their lack of effort. The Immutability of Belief subdimension of the

Fixed Mindset dimension of MTS is related to the idea that the students have a structure that does not change their intelligence and that they think of their intelligence as constant. The Belief in Improvement subdimension of MTS's Growth Mindset dimension measures students' beliefs that they think of their intelligence as a muscle and that they can improve it when they try to do so. The Effort sub-dimension of the Growth Mindset dimension includes the desire of the students to understand their mistakes while doing something, to learn from them and to make an effort.

When the validity and reliability values of MTS were reviewed, it was determined that the scale items could measure the quality they aimed to measure and differentiate the participants' level of quality aimed to be measured. Considering the expert opinions and its content validity MTS can be said to represent the universe aimed to be measured. The factor loads of the model can be accepted to be adequate based on the values obtained from exploratory factor analysis performed to test the structural validity of MTS. t values for the difference between top and bottom groups of the scale show that MTS can measure the structure it measures with enough differentiating power. The structure resulting from the EFA result MTS was tested with one, two and three level CFA, Fit indices of one level CFA showed that there is an adequate fit between the data and the model structure. Belief in Improvement, Effort, Procrastination and Immutability of Belief, revealed in EFA, was determined to be related to a higher level dimension in the literature. These dimensions are Growth and Fixed Mindset. It was determined by the second level CFA that it is a measurement tool that can be used to determine the levels of Fixed Mindset and Procrastination and Immutability of Belief and to determine the levels of total Growth Mindset and levels of Effort and Belief in Improvement. The good level of internal reliability coefficients related to the dimensions and subdimensions of MTS indicate that items of the dimensions and subdimensions are consistent with each other. MTS was found to have a reliable and valid structure as a result of this study.

The fact that MTS gives sufficient fit indices in the first, second and third level CFAs shows that it can be performed on the scores obtained from both dimensions and the subdimensions of the scale and it also reveals that the total score related to the Growth Mindset and Fixed Mindset dimension can be obtained from the scale. The increase in the scores obtained from the dimensions and subdimensions of the MTS means that there is high quality in that area.

The scales measuring the quality MTS aims to measure are generally labelled as Growth Mindset. The literature indicates that Growth Mindset consists of growing mentality and fixed mentality dimensions. This was judged to be an inconsistency between the subdimensions of the scales and their general name. However, when the literature is reviewed, it can be seen that the individuals' qualities of growing mentality and fixed mentality are related to their mental structures. Also in literature these are considered to be dimensions of mental theories. Because of these reasons, the scale developed in this study was called Mindset Theory Scale.

The age range of the study group is 14-22 during the development of the MTS. The validity and reliability studies of the scale for different developmental periods may be needed.

Ethic

I declare that the research was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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